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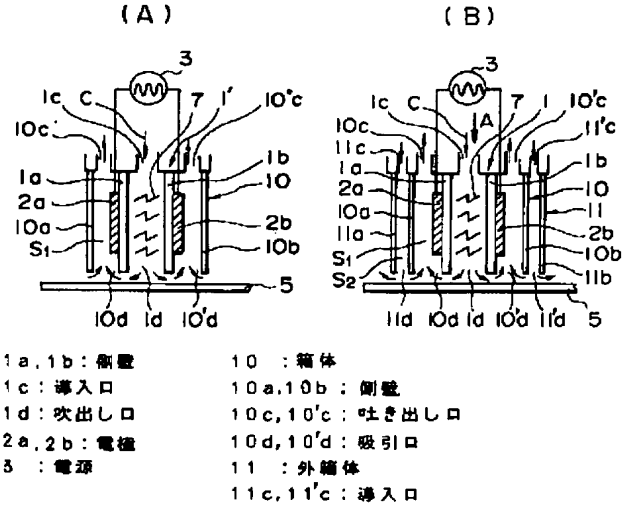
(54)【発明の名称】大気圧プラズマ表面処理装置

(57)【要約】

【目的】　大気圧プラズマ表面処理装置において、処理を終わった後吹き出す反応ガスの残部や副生成物が周囲に拡散するのを防止するか、あるいは少なくとも拡散量を減少させることの可能な吹出し形のプラズマ表面処理装置を提供する。

【構成】　電極２ａ，２ｂを有する誘電体の反応容器１の外周に、吹出しガスを吸引する空間を形成する箱体１０を設け、さらにその外周に別の空間を形成する外箱体１１を設けて不活性ガスを導入し大気反応容器内に巻き込まれない構成である。また別の実施例としての装置は、被処理物が繊維状の場合は被処理物に対し反応容器の反対側に、吹き出した処理済みのガスや外箱体からの不活性ガスの吐き出し口よりやや大きい開口を有する受け箱体を設けた構成である。



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【特許請求の範囲】

【請求項１】　大気圧下に対向して配置される１対の電極間の空隙の一方端から反応ガスとしてのフッ化炭素系あるいは炭化水素系物質などのガスと、ヘリウム、アルゴン、ネオンなどの希ガスまたはN_2等の不活性ガスとの混合ガスが導入され、前記電極間の他方端に静止、または移動可能に置かれる被処理物体の表面に吹き付けられて高周波、高電圧下でのグロー放電によりプラズマ化された前記混合ガスにより、前記被処理物体の表面を改質あるいは表面に例えばアモルファス炭素膜を析出形成させる大気圧プラズマ表面処理装置において、

前記表面処理装置は、

所定の間隔を保って対向して平行に配置された側壁と、その外表面上に前記１対の電極のそれぞれが配置され被処理物体の表面との間に所定距離の隙間を保って配置された１対の側壁と、前記両側壁の前後両端部間を連結する周壁と、これらの側壁と周壁の上面を覆う上壁とを有し、前記上壁の中央部に前記混合ガスの導入口が明けられ、前記側壁の下端と前記被処理物体との間の隙間が処理済みガスの吐き出し口を形成する箱状または筒状の誘電体製反応容器と、

この反応容器を囲んでさらに外周に配置されて前記両電極の表面との間に所定の空間を形成する１対の側壁と、前記両側壁の前後両端部間を連結する周壁と、これらの両側壁と周壁の上面を覆う上壁とを有し、この上壁上で前記反応容器の混合ガスの導入口に対しほぼ対称の位置に明けられた１対の処理済みガスの吐き出し口を有し、前記側壁の下端は前記被処理物体に対し前記反応容器の下端に対し所定の距離を保って配置される誘電体製箱体と、を有し、前記反応容器の下端から吐き出された処理済みガスが前記箱体の側壁と前記反応容器の側壁との間の空間を上方に流れて前記の吐き出し口を通過し回収されるようになっていることを特徴とする大気圧プラズマ表面処理装置。

【請求項２】　請求項１記載の大気圧プラズマ表面処理装置において；前記箱体の外周にさらに別の導電体製外箱体が付加して設けられ、この外箱体は前記箱体を囲んでさらに外周に配置されて前記箱体の両側面の外表面との間に所定の空間を形成する１対の側壁と、これらの両側壁の前後端部間を連結する周壁と、これらの両側壁と周壁の上面を覆う上壁とを有し、この上壁上で前記箱体の１対の処理済みガスの吐き出し口の外側にほぼ対称の位置に明けられた１対の不活性ガスの導入口を有して、前記側壁の下端は前記被処理物体に対し所定の距離を保って配置され、前記不活性ガスは前記箱体の両側壁の外表面と外箱体の内表面との間の空間を流れて前記箱体の側壁と前記反応容器の側壁との間の空間に流入して吐き出され、外部空気が前記反応容器内に流入するのを防止して、前記処理済みガスとともに前記箱体内を流れその上部の吐き出し口を通過し回収されることを特徴とする大気圧プラズマ表面処理装置。

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【請求項３】　請求項１又は２記載の大気圧プラズマ表面処理装置において；前記被処理物体は前記１対の電極中の一方の電極から他方の電極に向かう方向に移動されて処理され、前記反応容器と箱体のそれぞれ１対の側壁の下端は前記１対の電極の垂直中心軸面に向かって内向に傾斜され、前記外箱体の１対の側壁の下端は前記垂直中心軸面に対し外向に傾斜されていることを特徴とする大気圧プラズマ表面処理装置。

【請求項４】　大気圧下に対向して配置される１対の電極間の空隙の一方端から反応ガスとしてのフッ化炭素系あるいは炭化水素系物質などのガスと、ヘリウム、アルゴン、ネオンなどの希ガスまたはN_2等の不活性ガスとの混合ガスが導入され、前記電極間の他方端に静止しまたは移動可能に置かれる被処理物体の表面に吹き付けられて高周波、高電圧下でのグロー放電によりプラズマ化された前記混合ガスにより、前記被処理物体の表面を改質あるいは表面に例えばアモルファス炭素膜を析出形成させる大気圧プラズマ表面処理装置において、

前記被処理物体は織物、編物など前記混合ガスが通過可能な通気性繊維材料製であり、

前記表面処理装置は、

所定の間隔を保って対向して平行に配置されその外面上に前記１対の電極のそれぞれが配置され被処理物体の上方との間に所定距離の隙間を保って配置される１対の側壁と、前記両側壁の前後端部間を連結する周壁と、これらの両側壁と周壁の上面を覆う上壁とを有し、前記上壁の中央部に前記混合ガスの導入口が明けられ、前記側壁の下端に処理済みガスの吐き出し口を形成する箱状または筒状の誘電体製反応容器と、

この反応容器を囲んでさらに外周に配置され前記両電極の表面との間に所定の空間を形成するとともに前記反応容器のそれぞれの側壁の下端との間に１対の不活性ガスの吐き出し口を形成する１対の側壁と、前記両側壁の前後両端部間を連結する周壁と、前記両側壁と周壁の上面を覆う上壁とを有し、この上壁上で前記反応容器の混合ガスの導入口に対しほぼ対称の位置に１対の不活性ガスの導入口が明けられた誘電体製箱体と、

前記被処理物体に対し前記反応容器と箱体の反対側に、反応容器及び箱体のガス吹出し口の合計面積よりもやや大きい吸引口が上に向けて開口され、断面が四角形偏平で底部に吐き出し口が設けられた誘電体製の受箱体と、を含んで成り；

前記反応容器からの処理済みガスが、その外側を流れる前記箱体からの不活性ガスに囲まれてシールされた状態で前記被処理物体を通過して前記受箱体に吸引され回収されることを特徴とする大気圧プラズマ表面処理装置。

【請求項５】　請求項４記載の大気圧プラズマ表面処理装置において、

前記被処理物体は前記１対の電極中の一方の電極から他

方の電極に向かう方向に移動されて処理され、前記反応容器の側壁の下端は前記１対の電極の垂直中心軸面に向かって内向に傾斜され、前記箱体の１対の側壁の下端は前記垂直中心軸面に対し外向に傾斜され、前記受箱体の側壁は前記箱体の１対の側壁の下端よりも広く上向に傾斜されていることを特徴とする大気圧プラズマ表面処理装置。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】この発明は表面処理方法あるいは薄膜形成方法とその装置に関し、特に大気圧グロー放電プラズマによるプラズマ表面処理法あるいは製膜法に関する。

【０００２】

【従来の技術】金属、セラミック材など固体材料の表面に炭素膜、フッ化炭素膜などを形成するには、従来は反応ガスとしてのフッ化炭素系あるいは炭化水素系物質などのガスとヘリウム、アルゴン、ネオンなどの希ガスまたはN_2等の不活性ガスの混合ガスを真空槽内で高周波電界でプラズマ化してコーティング処理や薄膜形成を行っていたが、近年に至り真空発生装置や真空容器などを必要としない大気圧プラズマ表面処理法や薄膜形成法が要望されるにともない、開発が進められまた技術内容が開示されている。代表的なものとして、特願昭６３－１６６５９９（特開平２－１５１７１）、特願昭６１－１９３９３４（特開昭６３－５０４７８）、特願昭６３－１３８６３０（特開平１－３０６５６９）が挙げられる。図７は、これらの発明で使用される薄膜形成装置を模式的に示す概要立面図であり、図７のＡ－Ａ断面図を図８に示す。この装置の構造は、誘電体製の四角形箱状（または筒体）の反応容器１を構成して、その上下または左右に対向する側壁１ａ，１ｂ（図８では左右の側壁）の外表面に、それぞれ電極２ａ，２ｂを取り付け、高周波高電圧の電源３に接続し反応容器１の導入口１ｃから、ヘリウム（Ｈｅ）、ネオン（Ｎｅ）またはアルゴン（Ａｒ）などの希ガスまたはN_2等の不活性ガスとCF_4などのフッ化炭素系あるいは炭化水素系物質の反応ガスとの混合ガスを、矢印Ｃのように流し、導入口１ｃの反対側の吹出し口１ｄの下に被処理物体５を位置させ矢印Ｂの方向に移動するように置く。このような構造で、前記の混合ガスを流して電極２ａ，２ｂに高周波高電圧を印加すると、グロー放電７により混合ガスがプラズマ化し矢印Ｄのように流れ、そこに生成されるラジカルが吹出し口１ｄから吹き出されて被処理物体５の表面が改質あるいは表面に薄膜が形成される。

【０００３】

【発明が解決しようとする課題】上記の吹出し口から吹き出したガスは、被処理物体の表面を処理するとともに、大気中に拡散するが、この拡散ガスは上記の表面との反応によって、固体やガスとしての副生成物が生成され、周囲の環境を汚染し有害になる場合がある。そこで、吹出しガスや副生成物（固体及びガス）が周囲に拡散するのを防止するか、或いは少なくとも拡散量を減少させることが要望されていた。本発明はこれらの要望に対応する装置を提供することを目的とする。

【０００４】

【課題を解決するための手段】本発明は下記のような手段によりこの課題を解決した。

（１）電極を有し誘電体製で箱状の反応容器の周囲に、混合ガスが吹出し口から被処理物体の表面に接触して処理を終わった後に排出ガスとして吹き出されるガスを吸引する空間を形成するための箱体を設け、この箱体の外周に別の空間を形成する外箱体を設け、その上部からＡｒ，N_2等の不活性ガスを導入し下端から被処理物体に向け吹き出す構造にする。また、被処理物体が移動される場合には、前記の反応容器と箱体の側壁の被処理物体に対向する先端部を垂直中心軸面側に向け傾斜させる。

（２）被処理物体が通気性を有する織物などの繊維状の場合は、電極を有する誘電体製の箱状の反応容器の周囲に、Ａｒ，N_2等の不活性ガスを被処理物体に向けて吹き出す空間を画定する箱体を設け、また被処理物体に対し反応容器と反対側に、反応済み混合ガスと不活性ガスの合計吹き出し面積よりもやや大きい開口面積を有するガス吸引用の別の空間を画定する受箱体を設ける構造にする。移動する被処理物体の場合は（１）項に準ずる構造とする。

【０００５】

【作用】上記の（１）の場合、導入口から入った反応ガスはプラズマ化され、被処理物体を処理し未反応ガスと副生成ガス等となって反応容器の外の空間内に吸引され、外部の回収装置などにより回収されるが、この吸引の際に大気中の成分が混入して前記の処理に影響する場合は、混入を防止するための別の外箱体を設けてＡｒ，N_2等の不活性ガスが被処理物体に吹き付けられる。大気中の成分が混入しても処理に影響しない場合には、外箱体を省略することができる。また、移動する被処理物体の場合に、箱体及び各空間の壁の被処理物体に対向する先端部を傾斜させることにより、大気を巻き込み難くするとともに、未反応ガス及び不活性ガスの回収が確実に行われる。被処理物体が通気性の繊維材料製である上記（２）項の場合は、吹き付けられたプラズマは被処理物体を処理し、ガスの未反応分や副生成ガスは被処理物体を通過して吹き付け側と反対側に抜けて受箱体内に吸引されて環境を汚染しない。被処理物体が移動する場合は前記（１）項の場合と同様である。

【０００６】

【実施例】本発明による大気圧プラズマ表面処理装置の第１実施例の縦断面図を図１（Ｂ）に、図１（Ｂ）のＡ矢視図を図２に示す。これらの図において、先行技術として示した図７及び図８と同じ部材には同じ符号を付け

る。平面図で四角形の誘電体製箱状の反応容器１の、図で左右の両側壁１ａ，１ｂの外表面には、それぞれ電極２ａ，２ｂが取り付けられ、この電極２ａと２ｂは高周波、高電圧の電源３に接続される。箱状の反応容器１は、前記の両側壁１ａ，１ｂと、図で左右の両側壁間を連結する前後の周壁１ｆと、これら１対の側壁と周壁の上面を覆う上壁１ｅとから成り、この上壁には丸穴状の反応ガスの導入口１ｃが設けられ、下面は開口されてガスの吹出し口１ｄとなっていて、直立する両側壁１ａ，１ｂの下方には所定の距離を保って被処理物体５が水平に置かれている。反応容器１の外周には、空間S_1を形成するように側壁１０ａ，１０ｂを有する誘電体製で四角形の箱体１０が設けられ、容器自体の構造は前記の反応容器の構成とほぼ同一なので説明を省略する、箱体１０の上端の左右両側には吐き出し口１０ｃ，１０′ｃが前記反応容器１の導入口１ｃの両外側方に設けられ、前記の側壁１０ａ，１０ｂの下端部は、反応容器１の側壁１ａ，１ｂの下端部とほぼ同じ高さだけ被処理物体５の上面より上方に位置し、これらの側壁中で左、右の関係で同じ側にある側壁１ａと１０ａ、１ｂと１０ｂの下端部の間には、それぞれ、吸引口１０ｄと１０′ｄが形成される。箱体１０の外周には、さらに外側の空間S_2を形成するように導電体製で四角形の外箱体１１が設けられ、その上面の左右両外側には導入口１１ｃと１１′ｃが、それぞれ、前記の吐き出し口１０ｃ，１０′ｃの外側方に設けられ両側壁１１ａと１１ｂの下端部は、側壁１０ａ，１０ｂの下端部とほぼ同じ高さだけ被処理物体５の上面より上方に位置し、側壁１０ａと１１ａ、１０ｂと１１ｂのそれぞれの間は吐き出し口１１ｄ，１１′ｄを形成する。外気が混入してもこの処理に問題がない場合には、図１（Ａ）のように図１（Ｂ）に示した外箱体１１を省略し簡易型反応容器１とすることができる。

【０００７】図３は、被処理物体５が移動（図では矢印Ｂのように左方へ）される場合に対応するための第２実施例を示す縦断面図であり、反応容器２１の両側壁２１ａ，２１ｂと箱体３０の両側壁３０ａ，３０ｂの下端部は、それぞれ、垂直軸面側に向かって内方に、外箱体３１の両側壁３１ａ，３１ｂの下端部は垂直軸面に対して外側に向かって傾斜しているが、それ以外の点は図１と全く同様であり、外気が混入しても処理に問題がない場合は、図１（Ａ）に準じ外箱体１１を省略できる。

【０００８】次に上記第１と第２の実施例の装置の作用について説明する。図１及び図２を参照すると、反応容器１の導入口１ｃから入ったＣＦ₄などの反応ガスとＨｅ等の希釈ガスの混合ガスは、電極２ａ，２ｂに印加された高周波高電圧によるグロー放電７によりプラズマ化され、生成されたラジカルが吹出し口１ｄから吹き出て被処理物体５の表面を処理して改質した後、未反応ガスや、副生成ガス等となって吸引口１０ｄ，１０′ｄから空間S_1に入り吐き出し口１０ｃ，１０′ｃから図示しない回収容器に回収される。外箱体１１（３１）の導入口１１ｃ，１１′ｃ（３１ｃ，３１′ｃ）からＡｒ，N_2等の不活性ガスが導入され第２の空間S_2を経て吐き出し口１１ｄ，１１′ｄ（３１ｄ，３１′ｄ）から被処理物体５に吹き付けられて、一部は吸引口１０ｄ，１０′ｄ（３０ｄ，３０′ｄ）に吸引され、大部分は外方の大気へ吐き出され、大気中の成分が上記の表面改質の処理に影響を与えないように大気の侵入を遮断する。図３に示すように、被処理物体５が矢印Ｂの方向に移動される場合、各側壁の下端部がそれぞれ被処理物体５の表面に対して垂直中心軸面側に向かって傾斜して曲げられているので、大気の巻き込みを阻止するように作用すると同時に処理ガスの回収を一層確実にする。

【０００９】次に図４を参照して、被処理物体が織物または編物のような通気性構造の繊維状になっている場合に対応する第３実施例の縦断面図を示し、図５に図４のＡ矢視図を示す。この実施例の装置において、図１及び図２と同じ部材には同じ符号を付け、異なる点のみについて説明する。被処理物体２５は通気性繊維状で、箱体１０自体は構造が図１及び図２の場合と同じであるが、１０ｆ，１０′ｆは導入口で、１０ｇ，１０′ｇは吐き出し口であり、被処理物体２５に対してガス吐き出し側と反対側には、反応容器１及び第１の箱体１０のガス吐き出し口の合計面積よりもやや大きい吸引口１２ｄが上に向けて開口された偏平で断面が四角形の受箱体１２が備えられ、受箱体１２は誘電体製で下側には吐き出し口１２ｃが設けられている。大気が処理に影響を与えない場合は箱体１０を省略できる。図６は繊維状の被処理物体２５が移動（図で矢印Ｂのように左方へ）される場合の第４実施例を示し、第２実施例と同様に反応容器２１の両側壁２１ａ，２１ｂの下端部は被処理物体２５の表面に向かって傾斜し、箱体３０の両側壁３０ａ，３０ｂの下端部と下方の受箱体３２の両側壁３２ａ，３２ｂはそれぞれ外方へ傾斜しているが大気が処理に影響しない場合は実施例３と同様箱体１０を省略できる。

【００１０】上記の第３実施例の作用を以下に説明する。第１実施例（図１参照）と異なり、未反応ガスと副生成ガス等が通気性を有する被処理物体２５を通り抜けるので、処理装置の反対側にある受箱体１２により吸引し、処理部への大気の進入は繊維状の被処理物体２５に対し、箱体１０の吐き出し口１０ｇ，１０′ｇからの不活性ガスを吹き出させて阻止する。図６の第４実施例が示すように、被処理物体２５が矢印Ｂの方向へ移動する場合は、各側壁の端部が曲げられていて、大気の巻き込みが阻止されるとともに、ガスの回収を確実にすることは第２実施例（図３参照）と同様である。

【００１１】

【発明の効果】プラズマの吹出し口の周囲に吸引空間を設けることにより、また被処理物体が通気性を有する繊

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維状物体の場合は被処理物体に対し吹出し口と反対側に吸引空間を形成する受箱体を設けることにより、また被処理物体が処理の間移動される場合には、反応容器、箱体、外箱体、受箱体の被処理物体に対向する端面を適当な方向に傾斜させることにより反応に関係した処理済みの副生成ガスや未反応ガスが大気中に放出され環境に悪影響を与えたり、大気が反応容器内に流入し反応に悪影響を与えることも防止される。

【図面の簡単な説明】

【図１】本図の（Ａ）は本発明による大気圧プラズマ表面処理装置の１実施例の簡略型の模式縦断面図であり、本図の（Ｂ）は標準型を示す。

【図２】図１（Ｂ）のＡ矢視平面図である。

【図３】被処理物体が移動する場合に対処するための第２実施例の縦断面図である。

【図４】被処理物体が繊維状の場合に対処するための第３実施例の縦断面図である。

【図５】図４のＡ矢視図である。

【図６】被処理物体が繊維状で移動する場合に対処する第４実施例の縦断面図である。

【図７】従来の大気圧プラズマ表面処理装置の概要を示す立面図である。

【図８】図７のＡ－Ａ断面図である。

【符号の説明】

１，２１　反応容器

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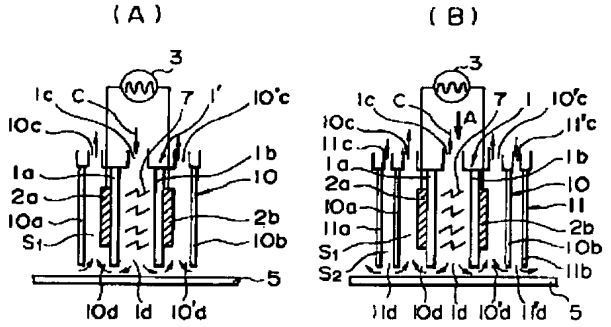
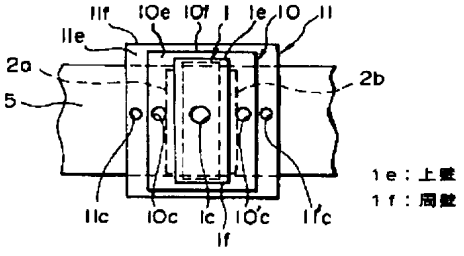
１ａ，１ｂ，２１ａ，２１ｂ　反応容器の側壁
１ｃ　導入口
１ｄ　吹出し口
１ｅ，１０ｅ，１１ｅ　上壁
１ｆ，１１ｆ　周壁
２ａ，２ｂ　電極
３　電源
５，２５　被処理物体
７　グロー放電
１０，３０　箱体
１０ａ，１０ｂ　箱体の側壁
１０ｃ，１０′ｃ　箱体の吐き出し口
１０ｄ，１０′ｄ　箱体の吸引口
１０ｆ，１０′ｆ　箱体の導入口
１０ｇ，１０′ｇ　箱体の吐き出し口
１１，３１　外箱体
１１ａ，１１ｂ，３１ａ，３１ｂ　外箱体の側壁
１１ｃ，１１′ｃ，３１ｃ，３１′ｃ　外箱体の導入口
１１ｄ，１１′ｄ　外箱体の吐き出し口
１２，３２：受箱体
１２ａ，１２ｂ，３２ａ，３２ｂ　受箱体の側壁
１２ｃ　受箱体の吐き出し口
１２ｄ　受箱体の吸引口
Ｂ，Ｃ　矢印
S_1，S_2　空間

【図１】

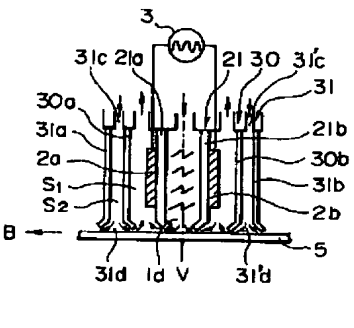


1a，1b：側壁　　10　：箱体
1c：導入口　　10a，10b：側壁
1d：吹出し口　　10c，10′c：吐き出し口
2a，2b：電極　　10d，10′d：吸引口
3　：電源　　11　：外箱体
11c，11′c：導入口

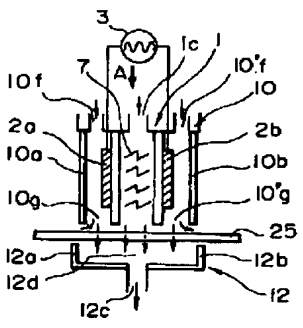
【図２】



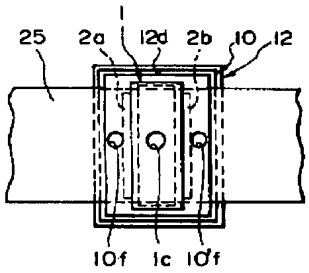
【図３】



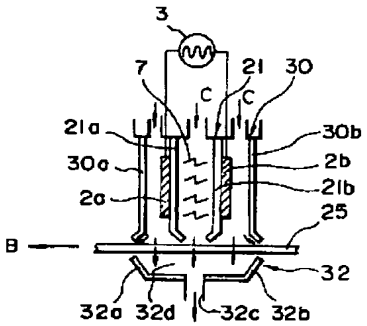
【図４】



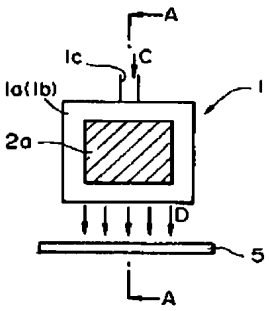
【図５】


1
25
2a
12d
2b
10
12
10f
1c
10f

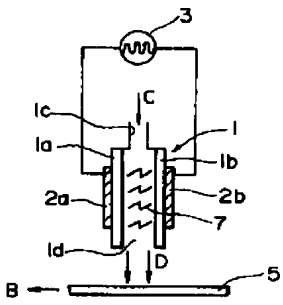
【図６】


3
7
21
30
C
C
21a
30a
2a
30b
2b
21b
25
B
32
32a
32d
32c
32b

【図７】


A
1c
C
1a(1b)
1
2a
D
5
A

【図８】


3
C
1c
1
1a
1b
2a
2b
7
1d
D
B
5

PATENT ABSTRACTS OF JAPAN

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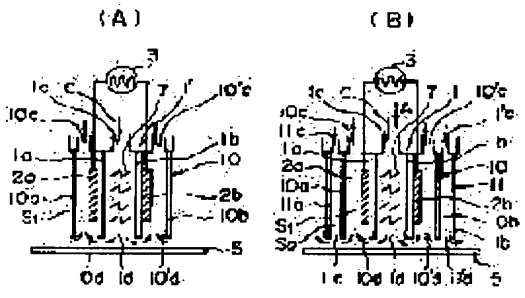
NAKAMURA AKIO

(54) ATMOSPHERIC PLASMA SURFACE TREATING DEVICE

(57)Abstract:

PURPOSE: To provide a plasma surface treating device of a blow off-type capable of preventing the diffusion of the remaining part of the reactive gas blowing off after the end of a treatment and their by-products to the circumference or at least decreasing the amt. of diffusion.

CONSTITUTION: This atm. plasma surface treating device is constituted by providing the outer periphery of a reaction vessel 1 consisting of a dielectric having electrodes 2a, 2b with a box body 10 forming a space to suck blow-off gases, further, providing the outer periphery thereof with an outside box body 11 forming another space on the outer periphery thereof and introducing an inert gas therein so as not to introduce the air into the reaction vessel.



The device as another embodiment is constituted by providing the opposite side of the reaction vessel with respect to the work with a receiving boxy body having an opening slightly larger than a discharge port for the blow-off and treated gases and the inert gas from the outside box when the work is fibrous.

LEGAL STATUS

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CLAIMS

[Claim(s)]

[Claim 1] On the other hand, one pair of inter-electrode openings which counter the bottom of atmospheric pressure and are arranged Gas, such as an edge to a carbon fluoride system as reactant gas or hydrocarbon system matter, rare gas, such as helium, an argon, and neon, or N2 Mixed gas with inert gas is introduced. etc. -- By said mixed gas which was sprayed on said inter-electrode another side edge on the front face of quiescence or the processed material object placed movable, and was plasma-ized by the glow discharge under a RF and the high voltage In the atmospheric pressure plasma surface treatment equipment which makes reforming or a front face carry out deposit formation of the amorphous carbon film for the front face of said processed material object said surface treatment equipment The side attachment wall which maintained predetermined spacing, countered and has been arranged in parallel, and one pair of side attachment walls which each of one pair of said electrodes has been arranged on the outside surface, and maintained the clearance between predetermined distance between the front faces of a processed material object, and have been arranged, It has a wrap upper wall for the top face of the peripheral walls which connect between said both-sides wall order both ends, and these side attachment walls and peripheral walls. The box-like or tubed reaction container made from a dielectric with which the inlet of said mixed gas breaks in the center section of said upper wall, and the clearance between the lower limit of said side attachment wall and said processed material object forms the discharge opening of processed gas in it, One pair of side attachment walls which surround this reaction container, are arranged further at a periphery, and form predetermined space between the front faces of said two electrodes, It has a wrap upper wall for the top

face of the peripheral walls which connect between said both-sides wall order both ends, and these both-sides walls and peripheral walls. It has the discharge opening of one pair of processed gas which besides ended in the location of the symmetry mostly to the inlet of the mixed gas of said reaction container on the wall. The dielectric box-manufacturing object which the lower limit of said side attachment wall maintains a predetermined distance to the lower limit of said reaction container to said processed material object, and is arranged, Atmospheric pressure plasma surface treatment equipment characterized by ****(ing) and the processed gas breathed out from the lower limit of said reaction container flowing the space between the side attachment wall of said box, and the side attachment wall of said reaction container up, and passing the aforementioned discharge opening and being collected.

[Claim 2] In atmospheric pressure plasma surface treatment equipment according to claim 1, still more nearly another tank object made from a conductor is added and prepared in the periphery of the; aforementioned box. One pair of side attachment walls which this tank object surrounds said box, are arranged further at a periphery, and form predetermined space between the outside surfaces of the both-sides side of said box, It has a wrap upper wall for the top face of the peripheral walls which connect between these both-sides walls order edges, and these both-sides walls and peripheral walls. It has the inlet of one pair of inert gas which besides broke mostly on the wall in the location of the symmetry on the outside of the discharge opening of one pair of processed gas of said box. To said processed material object, the lower limit of said side attachment wall maintains a predetermined distance, and is arranged. Said inert gas flows the space between the outside surface of the both-sides wall of said box, and the internal surface of a tank object, flows into the space between the side attachment wall of said box, and the side attachment wall of said reaction container, and is breathed out, and it prevents that exterior air flows in said reaction container. Atmospheric pressure plasma surface treatment equipment characterized by flowing the inside of said box, passing the discharge opening of the upper part, and being collected with said processed gas.

[Claim 3] In atmospheric pressure plasma surface treatment equipment according to claim 1 or 2, it is moved in the direction which faces to the electrode of another side from one electrode in said one pair of electrodes, and the; aforementioned processed material object is processed. It is atmospheric pressure plasma surface treatment equipment characterized by the thing of said reaction container and box which the lower limit of one pair of side attachment walls inclines in turning inward toward the

perpendicular medial-axis side of one pair of said electrodes, respectively, and the lower limit of one pair of side attachment walls of said tank object inclines in the extroversion to said perpendicular medial-axis side.

[Claim 4] On the other hand, one pair of inter-electrode openings which counter the bottom of atmospheric pressure and are arranged Gas, such as an edge to a carbon fluoride system as reactant gas or hydrocarbon system matter, rare gas, such as helium, an argon, and neon, or N2 Mixed gas with inert gas is introduced. etc. -- By said mixed gas which was sprayed on the front face of the processed material object which stands it still at said inter-electrode another side edge, or is placed movable, and was plasma-ized by the glow discharge under a RF and the high voltage In the atmospheric pressure plasma surface treatment equipment which makes reforming or a front face carry out deposit formation of the amorphous carbon film for the front face of said processed material object Said processed material object is the product made from permeability textile materials which can pass said mixed gas, such as textiles and knitting. Said surface treatment equipment One pair of side attachment walls which predetermined spacing is maintained, and it counters, and is arranged in parallel, and each of one pair of said electrodes is arranged on the external surface, and maintain the clearance between predetermined distance between the upper parts of a processed material object, and are arranged, It has a wrap upper wall for the top face of the peripheral walls which connect between said both-sides wall order edges, and these both-sides walls and peripheral walls. The box-like or tubed reaction container made from a dielectric which the inlet of said mixed gas breaks in the center section of said upper wall, and forms the discharge opening of processed gas in the lower limit of said side attachment wall, One pair of side attachment walls which form the discharge opening of one pair of inert gas between the lower limits of each side attachment wall of said reaction container while surrounding this reaction container, being arranged further at a periphery and forming predetermined space between the front faces of said two electrodes, The dielectric box-manufacturing object with which it has a wrap upper wall and the inlet of one pair of inert gas broke mostly the top face of the peripheral wall which connects between said both-sides wall order both ends, and said both-sides wall and peripheral wall in the location of the symmetry to the inlet of the mixed gas of said reaction container on this upper wall, a reaction container and a little larger suction opening than the sum total area of the gas exit cone of a box carry out opening to the opposite side of said reaction container and box towards a top to said processed material object -- having -- a cross section -- a square -- with the receiving box object made from a dielectric

with which it was flat and the discharge opening was prepared in the pars basilaris ossis occipitalis Atmospheric pressure plasma surface treatment equipment characterized by changing by ******, passing said processed material object where the seal of the processed gas from said reaction container is surrounded and carried out to inert gas from said box which flows the outside, being drawn in by said receiving box object and collected.

[Claim 5] In atmospheric pressure plasma surface treatment equipment according to claim 4, it is moved in the direction which faces to the electrode of another side from one electrode in said one pair of electrodes, and said processed material object is processed. The lower limit of the side attachment wall of said reaction container inclines in turning inward toward the perpendicular medial-axis side of one pair of said electrodes. The lower limit of one pair of side attachment walls of said box is atmospheric pressure plasma surface treatment equipment characterized by inclining in the extroversion to said perpendicular medial-axis side, and the side attachment wall of said receiving box object inclining in top ** more widely than the lower limit of one pair of side attachment walls of said box.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] Especially this invention relates to the plasma surface treatment method or the producing-film method by the atmospheric pressure glow discharge plasma about the surface treatment approach or the thin film formation approach, and its equipment.

[0002]

[Description of the Prior Art] In order to form a carbon film, a fluoride carbon film, etc. in the front face of solid materials, such as a metal and ceramic material the former -- gas, such as a carbon fluoride system as reactant gas, or hydrocarbon system matter, rare gas, such as helium, an argon, and neon, or N2 etc., although the mixed gas of inert gas was plasma-ized by high frequency electric field within the vacuum tub and coating processing and thin film formation were performed The atmospheric pressure plasma surface treatment method and the thin film forming method which continue till recent years and need neither a vacuum generator nor a vacuum housing follow on being requested, development is furthered, and technical contents are indicated again. As a typical thing, Japanese Patent Application No. 63-166599 (JP,2-15171,A), Japanese Patent Application No. 61-193934

(JP,63-50478,A), and Japanese Patent Application No. 63-138630 (JP,1-306569,A) are mentioned. Drawing 7 is the outline elevation showing typically the thin film deposition system used by these invention, and shows the A-A sectional view of drawing 7 to drawing 8 . The structure of this equipment constitutes the square box-like (or barrel) reaction container 1 made from a dielectric. To the outside surface of the side attachment walls 1a and 1b (side attachment wall of right and left in drawing 8) which counter the upper and lower sides or right and left Electrode 2a and 2b are attached, respectively and it connects with the power source 3 of the RF high voltage. From inlet 1c of the reaction container 1 rare gas, such as helium (helium), neon (Ne), or an argon (Ar), or N2 etc. -- inert gas and CF4 etc. -- mixed gas with the reactant gas of a carbon fluoride system or the hydrocarbon system matter It places so that the processed material object 5 may be located like an arrow head C under 1d of exit cones of the opposite side of sink and inlet 1c and it may move in the direction of an arrow head B. If the aforementioned mixed gas is passed and the RF high voltage is impressed to electrode 2a and 2b with such structure, mixed gas will plasma-ize by glow discharge 7, it will flow like an arrow head D, the radical generated there will blow off from 1d of exit cones, and a thin film will be formed in reforming or a front face for the front face of the processed material object 5.

[0003]

[Problem(s) to be Solved by the Invention] Although the gas which blew off from the above-mentioned exit cone is diffused in atmospheric air while it processes the front face of a processed material object, the by-product as a solid-state or gas may be generated by the reaction with the above-mentioned front face, this diffusion gas may pollute a surrounding environment by it, and it may become harmful. Then, it was requested that it prevented that blow-off gas and a by-product (a solid-state and gas) are spread around, or a diffusing capacity was decreased at least. This invention aims at offering the equipment corresponding to these requests.

[0004]

[Means for Solving the Problem] This invention solved this technical problem with the following means.

(1) the tank object which has an electrode, prepares the box for forming the space which attracts the gas which blows off as an exhaust gas after mixed gas contacts the front face of a processed material object from an exit cone and finishes processing with the perimeter of a reaction container the product made from a dielectric, and box-like, and forms another space in the periphery of this box --

preparing -- that upper part to Ar and N2 etc. -- it makes the structure which introduces inert gas and blows off towards a processed material object from a lower limit. Moreover, when a processed material object is moved, the point which counters the processed material object of the side attachment wall of the aforementioned reaction container and an aforementioned box is turned to a perpendicular medial-axis side side, and is made to incline.

(2) When the textiles which have permeability have a fibrous processed material object the perimeter of the box-like reaction container made from a dielectric which has an electrode -- Ar and N2 The box which demarcates the space which turns inert gas to a processed material object, and blows off is prepared. etc. -- Moreover, it is made the structure of preparing the receiving box object which demarcates another space for gas suction which has a little larger opening area than the sum total blowdown area of reacted mixed gas and inert gas in a reaction container and the opposite side, to a processed material object. In the case of the processed material object which moves, it is made into the structure according to (1) term.

[0005]

[Function] Although the reactant gas which entered from the inlet is plasma-ized in the case of above (1), and process a processed material object, and it becomes a unconverted gas, subgeneration gas, etc., and is drawn in in the space besides a reaction container and it is recovered by the external recovery system etc. another tank object for preventing mixing, when the component in atmospheric air mixes in the case of this suction and it influences the aforementioned processing -- preparing -- Ar and N2 etc. -- inert gas is sprayed on a processed material object. A tank object can be omitted when not influencing processing, even if the component in atmospheric air mixes. Moreover, while making atmospheric air hard to involve in by making the point which counters a box and the processed material object of the wall of each space incline in the case of the processed material object which moves, recovery of a unconverted gas and inert gas is ensured. When a processed material object is the above-mentioned (2) term which is the product made from textile materials of permeability, the sprayed plasma processes a processed material object, and the unreacted part of gas and subgeneration gas pass a processed material object, escape from it to the opposite side a blasting side, are attracted by the receiving box inside of the body, and do not pollute an environment. When a processed material object moves, it is the same as that of the case of the aforementioned (1) term.

[0006]

[Example] Drawing of longitudinal section of the 1st example of the atmospheric pressure plasma surface treatment equipment by this invention is shown in drawing 1 (B), and A view Fig. of drawing 1 (B) is shown in drawing 2 . The same sign is attached to the same member as drawing 7 and drawing 8 which were shown as advanced technology in these drawings. Electrode 2a and 2b are attached in the outside surface of the both-sides walls 1a and 1b of right and left in drawing of the reaction container 1 of the shape of square dielectric box manufacturing with a top view, respectively, and this electrode 2a and 2b are connected to the power source 3 of a RF and the high voltage. 1f of peripheral walls before and after the box-like reaction container 1 connects between the aforementioned both-sides walls 1a and 1b and the both-sides wall of right and left in drawing, The top face of these one pairs of side attachment walls and a peripheral wall is consisted of wrap upper wall 1e, inlet 1c of round hole-like reactant gas is prepared in this upper wall, opening of the inferior surface of tongue is carried out, it serves as 1d of exit cones of gas, a predetermined distance is maintained under the both-sides walls 1a and 1b which stand straight, and the processed material object 5 is placed horizontally. In the periphery of the reaction container 1, it is space S1. The square box 10 is formed by the product made from a dielectric which has side attachment walls 10a and 10b so that it may form. Since the structure of the container itself is identitas mostly, it abbreviates explanation to the configuration of the aforementioned reaction container. Discharge opening 10c and 10'c are prepared in the right-and-left both sides of the upper limit of a box 10 at the method of both outsides of inlet 1c of said reaction container 1. The lower limit section of the aforementioned side attachment walls 10a and 10b Only the almost same height as the lower limit section of the side attachment walls 1a and 1b of the reaction container 1 is located more nearly up than the top face of the processed material object 5, and 10d of suction openings and 10'd are formed, respectively between the lower limit sections of side-attachment-wall 1a which is in the same side due to the left and the right in these side attachment walls, and 10a, 1b and 10b. In the periphery of a box 10, it is the outside space S2 further. The square tank object 11 is established by the product made from a conductor so that it may form. Inlet 11c and 11'c are prepared in right-and-left both the outsides of the top face at the method of an outside of the aforementioned discharge opening 10c and 10'c, respectively. The lower limit section of the both-sides walls 11a and 11b Only the almost same height as the lower limit section of side attachment walls 10a and 10b is located more nearly up than the top face of the processed material object 5, and they are 11d of discharge openings, and 11'd between each of

side-attachment-wall 10a, and 11a, 10b and 11b. It forms. Even if the open air mixes, when there is no problem in this processing, the tank object 11 shown in drawing 1 (B) like drawing 1 (A) can be omitted, and it can consider as the short form reaction container 1.

[0007] Drawing 3 is drawing of longitudinal section showing the 2nd example for corresponding when the processed material object 5 is moved to a left drawing -- an arrow head B -- like. Although the lower limit section of the both-sides walls 31a and 31b of the tank object 31 inclines toward an outside in the method of inside to a perpendicular axial plane toward a perpendicular axial plane side, the lower limit section of the both-sides walls 21a and 21b of the reaction container 21, and the both-sides walls 30a and 30b of a box 30, respectively Even if the other point is completely the same as that of drawing 1 and the open air mixes, when there is no problem in processing, the tank object 11 can be omitted according to drawing 1 (A).

[0008] Next, an operation of the equipment of the above 1st and the 2nd example is explained. CF4 which entered from inlet 1c of the reaction container 1 when drawing 1 and drawing 2 were referred to etc. -- the mixed gas of reactant gas and dilution gas, such as helium It is plasma-ized by the glow discharge 7 by the RF high voltage impressed to electrode 2a and 2b. The generated radical blows and comes out of 1d of exit cones, after processing and reforming the front face of the processed material object 5, it becomes a unconverted gas, subgeneration gas, etc., and they are 10d of suction openings, and space S1 from 10'd. It is collected by the container for recycling which it enters and is not illustrated from discharge opening 10c and 10'c. inlet 11c of the tank object 11 (31), and 11'c (31c, 31'c) to Ar and N2 etc. -- inert gas introduces -- having -- the 2nd space S2 The processed material object 5 is sprayed from 11d of discharge openings, and 11'd (31d, 31'd). pass -- A part is attracted by 10d of suction openings, and 10'd (30d, 30'd), and most is breathed out to the atmospheric air of the method of outside, and it intercepts an atmospheric invasion so that processing of the surface treatment of the above [the component in atmospheric air] may not be affected. Since the lower limit section of each side attachment wall inclines and is bent toward the perpendicular medial-axis side side to the front face of the processed material object 5, respectively when the processed material object 5 is moved in the direction of an arrow head B as shown in drawing 3 , recovery of raw gas is made much more reliable at the same time it acts so that atmospheric contamination may be prevented.

[0009] Next, with reference to drawing 4 , when the processed material object is fibrous [of permeability structure like textiles or knitting], drawing of longitudinal

section of the 3rd example is shown, and A view Fig. of drawing 4 is shown in drawing 5 . In the equipment of this example, the same sign is attached to the same member as drawing 1 and drawing 2 , and only a different point is explained. Although the processed material object 25 is permeability fibrous and box 10 the very thing is the same as the case where structures are drawing 1 and drawing 2 10f and 10'f are inlets, 10g and 10'g are discharge openings, and the processed material object 25 is received. In the opposite side, a gas discharge side opening of the reaction container 1 and the 12d of a little larger suction openings than the sum total area of the gas discharge opening of the 1st box 10 was carried out towards the top -- it is flat, and has the square receiving box object 12 for a cross section, and, as for the receiving box object 12, discharge opening 12c is prepared in the bottom by the product made from a dielectric. A box 10 can be omitted when atmospheric air does not affect processing. Drawing 6 shows the 4th example in case the fibrous processed material object 25 is moved to a left drawing -- an arrow head B -- like. The lower limit section of the both-sides walls 21a and 21b of the reaction container 21 inclines toward the front face of the processed material object 25 like the 2nd example. The both-sides walls 32a and 32b of the receiving box object 32 of the lower limit section of the both-sides walls 30a and 30b of a box 30 and a lower part can omit a box 10 like an example 3, when atmospheric air does not affect processing, although it inclines toward the method of outside, respectively.

[0010] An operation of the 3rd above-mentioned example is explained below. Since a unconverted gas, subgeneration gas, etc. pass through the processed material object 25 which has permeability unlike the 1st example (refer to drawing 1), it draws in with the receiving box object 12 in the opposite side of a processor, and to the fibrous processed material object 25, penetration of the atmospheric air to the processing section makes 10g of discharge openings of a box 10, and the inert gas from 10'g blow off, and is prevented. While the edge of each side attachment wall is bent and atmospheric contamination is prevented when the processed material object 25 moves in the direction of an arrow head B as the 4th example of drawing 6 shows, it is the same as that of the 2nd example (refer to drawing 3) to ensure recovery of gas.

[0011]

[Effect of the Invention] By establishing suction space in the perimeter of the exit cone of the plasma, in the case of the fibrous body with which a processed material object has permeability, moreover, by establishing the receiving box object which forms suction space in an exit cone and the opposite side to a processed material object moreover, when a processed material object is moved during processing By

making the end face which counters the processed material object of a reaction container, a box, a tank object, and a receiving box object incline in the suitable direction, subgeneration gas and the unconverted gas related to a reaction are emitted into atmospheric air, it has a bad influence on an environment, or atmospheric air flowing in a reaction container and having a bad influence on a reaction is also prevented. [finishing / processing]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] (A) of this Fig. is ** type drawing of longitudinal section of the simple mold of one example of the atmospheric pressure plasma surface treatment equipment by this invention, and (B) of this Fig. shows the normal mode.

[Drawing 2] It is A view top view of drawing 1 (B).

[Drawing 3] It is drawing of longitudinal section of the 2nd example for coping with it, when a processed material object moves.

[Drawing 4] It is drawing of longitudinal section of the 3rd example for coping with it, when a processed material object is fibrous.

[Drawing 5] It is A view Fig. of drawing 4 .

[Drawing 6] It is drawing of longitudinal section of the 4th example which copes with it when a processed material object is fibrous and moves.

[Drawing 7] It is the elevation showing the outline of conventional atmospheric pressure plasma surface treatment equipment.

[Drawing 8] It is the A-A sectional view of drawing 7 .

[Description of Notations]

1 21 Reaction container

1a, 1b, 21a, 21b Side attachment wall of a reaction container

1c Inlet

1d Exit cone

1e, 10e, 11e Upper wall

1f, 11f Peripheral wall

2a, 2b Electrode

3 Power Source

5 25 Processed material object

7 Glow Discharge

10 30 Box

10a, 10b Side attachment wall of a box

10c, 10'c Discharge opening of a box

10d, 10'd Suction opening of a box

10f, 10'f Inlet of a box

10g, 10'g Discharge opening of a box

11 31 Tank object

11a, 11b, 31a, 31b Side attachment wall of a tank object

11c, 11'c, 31c, 31'c Inlet of a tank object

11d, 11'd Discharge opening of a tank object

12 32: Receiving box object

12a, 12b, 32a, 32b Side attachment wall of a receiving box object

12c The discharge opening of a receiving box object

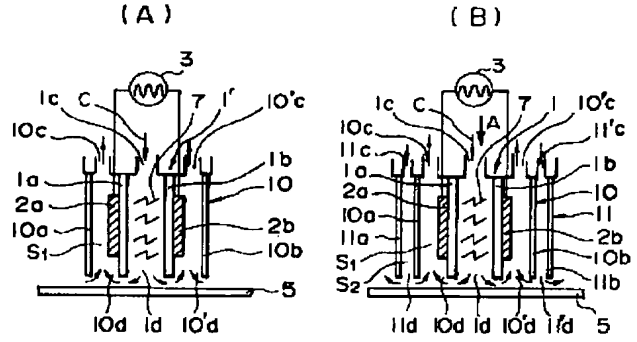
12d Suction opening of a receiving box object

B, C Arrow head

S1, S2 Space

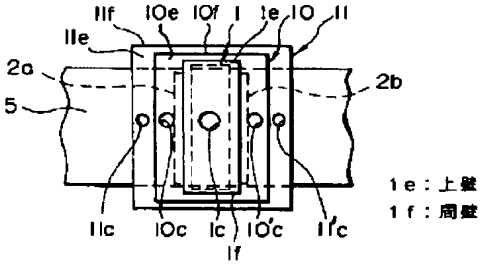
DRAWINGS

[Drawing 1]

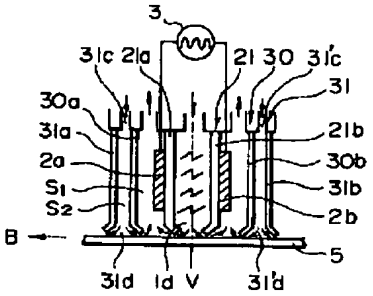


1a, 1b：側壁	10 ：箱体
1c：導入口	10a, 10b：側壁
1d：吹出し口	10c, 10'c：吐き出し口
2a, 2b：電極	10d, 10'd：吸引口
3 ：電源	11 ：外箱体
	11c, 11'c：導入口

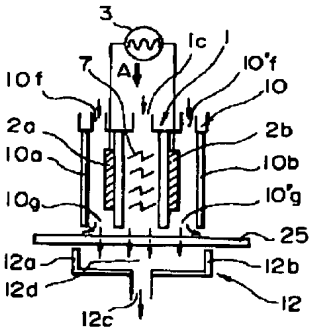
[Drawing 2]



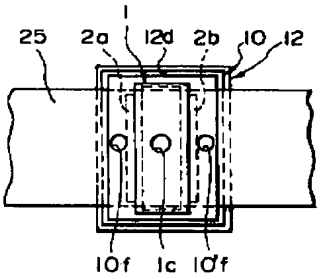
[Drawing 3]



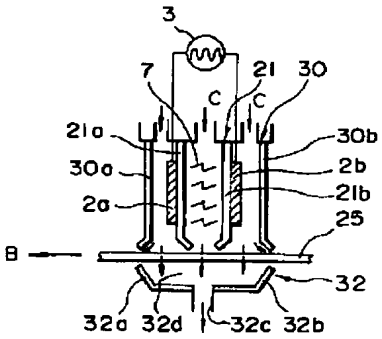
[Drawing 4]



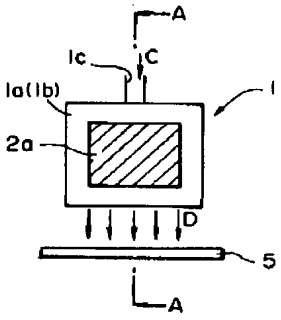
[Drawing 5]



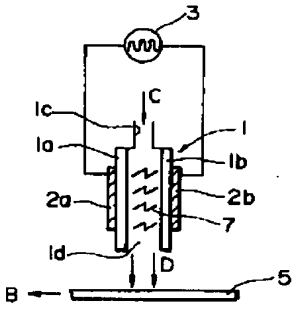
[Drawing 6]



[Drawing 7]



[Drawing 8]



[Translation done.]